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# Compositional Control of Sub-Critical Crack Growth in Silicate Glasses

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Improving the mechanical reliability of glass and its resistance to breakage is important for enabling advanced glass applications. The presence of water in the surrounding atmosphere can cause sub-critical crack growth (SCCG) in glasses, a phenomenon known as fatigue or stress corrosion. To facilitate the compositional design of more fatigue-resistant glasses, we here investigate the composition dependence of SCCG by studying fourteen silicate glasses [1]. The fatigue curves ( $V\text{-}K_I$ ) have been obtained by indentation experiments through measurements of the crack length as a function of post-indentation fatigue duration. Interestingly, we find that the fatigue resistance parameter  $N$  is generally improved by increasing the alumina content and is thereby found to exhibit a fairly linear dependence on the measured Vickers hardness  $H_V$  for a wide range of  $N$  and  $H_V$  values. This finding highlights the important role of network topology in governing the SCCG in silicate glasses, since hardness has been shown to scale linearly with the number of atomic constraints [2-5]. Our results therefore suggest that glasses showing under-constrained flexible networks, which feature floppy internal modes of deformation, are more readily attacked by water molecules, thus promoting stress corrosion and reducing the fatigue resistance.

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